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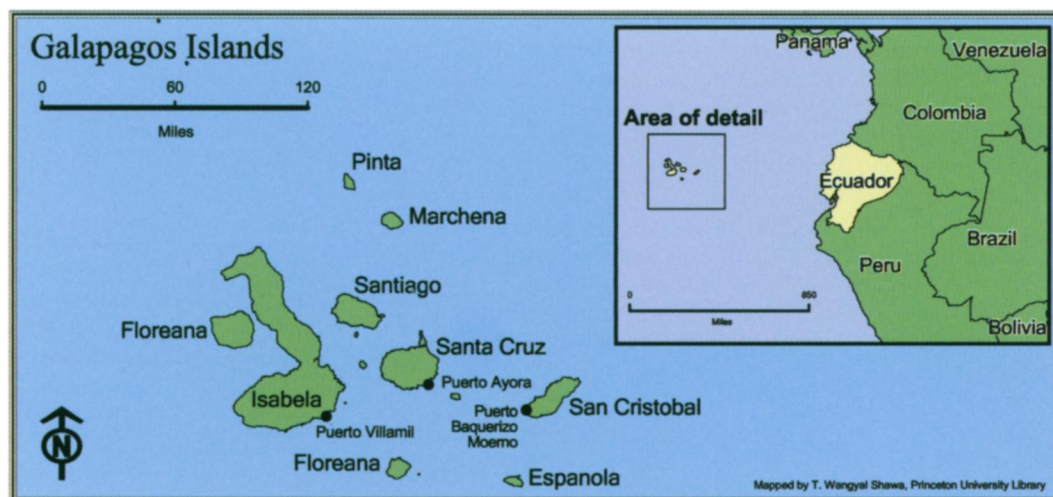
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A Case Study of Human Migration and the Sea Cucumber Crisis in the Galapagos Islands



The sea cucumber fishing crisis in Galapagos is an example of the potential consequences of rapid migration, growing economic competition, and weak regulatory mechanisms. In a short period of time sea cucumber fishing has become the most inflammatory issue in the Galapagos. The key factors that allowed for the efficient exploitation of the new resource were not the fishermen themselves but rather the new fishing techniques and access to credit and markets. This suggests that the annual sea cucumber crisis is due to factors more complex than simply more fishermen generating greater sea cucumber catches. This paper examines census data and fisher registries to analyze population growth in the islands. A public opinion survey is used to determine the population's attitudes toward sea cucumber fishing and regulations. Qualitative interviews explore the history of the sea cucumber boom. Information from the sea cucumber monitoring program provides estimates for the annual sea cucumber catches.

INTRODUCTION

The Galapagos Islands, located 1000 kilometers from the Ecuadorian coast, have been treasured as a unique place since Charles Darwin first visited them in 1835. The archipelago is the natural habitat of vast numbers of endemic species, and is one of the most well preserved natural island systems in the world. Recognizing this richness, the Ecuadorian government created the Galapagos National Park in 1959, and the Galapagos Marine Reserve in 1986.

It was not until late in the 19th century that pioneers began to think of colonizing the Galapagos. Several first attempts failed, but early in the 20th century small groups of colonists managed to establish themselves permanently on several islands (1). By 1959, when the Galapagos National Park was created, there were only 1000 to 2000 residents spread out on 4 of the 13 islands, and thus, the Ecuadorian government decreed that 97.5% of the islands would be reserved as National Park and the other 2.5% set aside for human settlement. Since the early 1980s, however, the population has grown to more than 15 000 inhabitants.

In an effort to study population-environment linkages in coastal areas The John D. and Catherine T. MacArthur Foundation generously provided The Nature Conservancy, Fundación Natura-Ecuador, and the World Wide Fund for Nature funding to implement a study of migration in the Galapagos and Machalilla National Parks in Ecuador. The study sought to determine: i) the factors that lead people to migrate to these important natural areas; ii) the effects these migrants have on resources and services; and iii) how the existence of these two national parks affect migration and consumption patterns.

One of the research questions of the larger study was the following: What are the effects of human migration on sea cucumber fishing in the Galapagos National Park and Marine Reserve?

Hypothesis: We expected that part of any explanation would be that both migration and technological changes increased catches, diversified target species, and led to growing economic competition, thus resulting in a social and political crisis surrounding the sea cucumber (*Isostichopus fuscus*) population.

One of the principal conservation issues in the Galapagos Islands is the conflict over marine resources (2, 3). Opinions vary greatly regarding the sustainability of select fisheries such as the sea cucumber, lobster, shark, and tuna. Conservation organizations and the Ecuadorian government increasingly have become concerned with the rapid exploitation of the marine reserve and the sea cucumber species *Isostichopus fuscus*, in particular.

Sea cucumber fishing has become one of the most lucrative industries in the Galapagos. The origins of this industry and the necessary technologies are related to the globalization of the sea cucumber market, the arrival of Asian exporters, and the temporary and permanent migration of fishermen from coastal areas of Ecuador. From its onset the sea cucumber industry created dramatic political and social strife in the archipelago. Seasonal restrictions and quotas have led to an annual crisis of protests and conflicts between fishermen and park administrators. Unimpeded migration quickly has become the social scapegoat for many conservation issues, without a true understanding of the linking mechanisms between the growing population and the Galapagos ecosystems.

There has been a call among population-environment schol-

ars for micro-level analysis that helps explain the migration decision-making behavior as well as the consumption mechanisms linking population and environment variables (4, 5). The linkage of these variables, in this case, is more complex than previously reported in other reviews of this Population-Environment Relationship (6, 7). This case study will explore these linking mechanisms, and determine the role of migration in the annual sea cucumber fishing crisis in Galapagos.

METHODOLOGY

Demographic information was acquired from the database of the Special Census for Galapagos that was implemented in November 1998 by The Instituto Nacional Ecuatoriano del Censo (8), in response to national and international concerns about migration to the islands. In addition to the census, two smaller-scale surveys allowed the research team to fill in information gaps. Fundación Natura implemented their annual household survey of public opinion in the Galapagos. The survey in 1999 was implemented with 582 randomly selected heads of household distributed across the three main islands. The survey measures public opinion with regard to various conservation issues and the implementing institutions. Several questions on migration were added to the standard questionnaire used in previous years. Respondents were asked if they were migrants or natives, thus allowing for disaggregated analysis.

Qualitative information on migrants' motives, paths of arrival, family networks, and other subjects was collected in the Galapagos through key informant interviews and focus groups. These methods were employed in the three main fishing ports: Puerto Baquerizo Moreno on the island of San Cristóbal; Puerto Ayora on Santa Cruz; and Puerto Villamil on Isabela. Tracing of migrant fishermen was used to identify migrants' points of origin. Focus groups also were executed with fishermen at points of origin near Machalilla National Park.

In the Machalilla area, similar focus groups and key-informant interviews were implemented in four fishing ports: Puerto Cayo, Machalilla, Porto Lopez, and Salango. Additional interviews were executed in Salango after it was determined that a subset of divers had a significant connection with the Galapagos. In both the Galapagos and Machalilla, independent fishermen and those belonging to cooperatives were interviewed.

A fisheries scientist studied fishing practices in the Galapagos and Machalilla from March–April 1999 to determine if new technologies had arrived at the Galapagos Islands with the in-migration of coastal fishermen. The fisheries scientist reviewed available literature, carried out group and key-informant interviews, and performed observations and photographed fishermen at docks in several ports (9).

The Charles Darwin Scientific Station's Sea Cucumber Monitoring Program collects data on sea cucumber catches annually. The program consists of on-board observations, dock observations, and control and study plots within the fishing area. The program scientists estimate that they were able to monitor 70% of the sea cucumber exported from the islands in 1999 (10).

RESULTS AND DISCUSSION

Census information illustrates the rapid growth of the population in the Galapagos. In November 1998, the population exceeded 15 000 inhabitants. The annual growth rate has remained at nearly 6.0% from 1982 to 1998 (Table 1). These rates are very high when compared with the national annual population growth rate of 2.1%. Closer analysis of data reveals that the population growth is due primarily to migration, and that approximately 25% of the total population consists of recent migrants who arrived at the Galapagos between 1993 and 1998 (11).

Although tourism has been the principal economic attraction of the Galapagos, the second most important economic activity in the islands is fishing. Government policies allow only small-scale, nonindustrial fishing within the reserve. Despite these limitations, coastal fishermen have migrated to the islands due to the depleted fisheries on the coast and the promise of greater opportunities in the Galapagos (6, 7, 11).

Between 1993 and 2000, during the sea cucumber boom, the number of registered fishers grew by 74%, from 392 to 682 (Table 2). The growth in the number of fishermen likely is due to two factors. First, the arrival of both permanent and seasonal migrants from the Ecuadorian coast, and second, Galapagos natives who traditionally did not fish have begun to fish during the lucrative lobster and sea cucumber seasons. In reality, the registration figures probably underestimate the growth of the fishing industry. Fishing cooperative memberships as well as peak season observations estimate the number of fishers to have been more than 700 in 1999, and more than 1200 in 2000 (12).

Migration greatly increased economic competition, and at the same time was blamed for a number of the conservation prob-

Table 1. Population growth and annual growth rates in Galapagos: 1982–1998. Sources: (8, 16, 17).

Year	Total population	Annual growth rate
1982*	6119	—
1990*	9785	6.0
1998	15 311	5.8

* Does not include tourists.

Table 2. Number of registered fishers in Galapagos.

Year	Total Registered Fishers
1993 _a	392
1996 _b	496
1997 _c	457
1999 _d	613
2000 _d	682

Sources: a. (3). b. (3). c. Cooperative registers and government registers (unpublished). d. National Park registers (unpublished).

Table 3. Public opinion regarding the greatest priorities for the Galapagos. Source: (3).

Priority	Total Population	Migrants	Natives
Control migration	33.2	27.8	38.1
Regulate the use of natural resources	18.9	21.4	16.7
Control introduced species	24.2	24.9	23.5
Protect the fauna	9.2	11.2	7.4
Protect the flora	14.0	14.2	13.9
All are a priority	0.4	0.6	0.3

Table 4. Levels of agreement with the Statement, "Fishing moratoriums benefit fishermen." Source: (3).

	Strongly	Disagree	Neither agree nor disagree	Agree	Strongly Agree	Don't know/ No response
Total population	1.6	10.4	8.1	58.9	20.7	0.3
Migrants	1.7	13.2	9.9	49.1	26.1	—
Natives	1.6	8.0	6.4	67.8	15.8	0.5
Isabela	1.2	8.7	5.0	62.5	22.5	—

lems in the islands. In 1998, a special law of the Galapagos was passed that greatly restricts future migration to the islands. The 1999 public opinion survey reveals that the population of the islands still is very concerned with rapid migration. Both migrants and natives believe that controlling migration is the greatest priority for the population (Table 3). The survey also illustrates that controlling the use of natural resources ranks just third among priorities in the Galapagos, suggesting that people are more concerned with controlling the number of users than controlling the use of resources.

When questioned about specific regulations, the majority of migrants and natives agreed that fishing moratoriums benefit fishermen (Table 4). In addition, respondents from the island of Isabela, where the majority of the population is dedicated to fishing, also agreed with moratoriums. Conflicting perceptions regarding sea cucumber fishing can be seen in the large numbers of people who agree and disagree with sea cucumber fishing (Table 5). Greater numbers of natives are in agreement with sea cucumber fishing than migrants, which seems to contradict earlier reviewers' belief that the sea cucumber crisis is related to migration (7). Not surprisingly, the population of Isabela that depends heavily on fishing income was almost entirely in agreement with sea cucumber fishing.

These conflicting perceptions about the importance of sea cucumber fishing have contributed greatly to protests. Differing opinions divide those who earn their livelihood from conservation and those whose livelihood comes from the sea. Despite the near universal acceptance of the benefits of fishing moratoriums, the high stakes and consequent annual protests now threaten the integrity of the moratorium and occasionally overturn regulation decisions.

Closer Examination of the Sea Cucumber Boom

According to natives and older migrants in Isabela, the first large in-migration of coastal fishermen to the Galapagos coincided with the lucrative boom of lobster fishing from 1982 to 1984. These migrant fishermen introduced new fishing techniques that were already being used on the coast, such as the trident, which is used for spearing lobster, and the air compressor, which is used for breathing during diving (9). Additionally, the investment capital of the lobster exporters and the knowledge of coastal fishermen led to the improvement of boat materials, construction techniques, and means of propulsion. Despite the investments, by the late 1980s fishermen reported that catch per unit effort (CPUE) for lobster had increased, and profitability had declined sharply.

During the same period, there was a dramatic increase in international trade of sea cucumbers for food (13). Sometime during this expansion in the global market, Asian exporters began working with coastal fishermen in Ecuador to exploit the sea cucumber. It is not clear whether these Asians arrived in Ecuador during the 1980s, or whether they were the descendents of Asians who had migrated to Peru and Ecuador. The fishery grew rapidly, and by 1991 was exhausted commercially along the Ecuadorian mainland.

The exporters and coastal fishermen began to look for new areas to fish, and sometime in 1991 or 1992 intensive fishing of the sea cucumber began in the Galapagos (13).

Salango is one of several mainland coastal communities that played an important role in the growth of sea cucumber fishing. Salango traditionally has been a coastal village of reef divers, and today lobster, octopus, conch, and sea cucumber are still the principal target species for Salangueno fishermen. Many Salangueno fishermen reported working closely with Asian merchants. The following testimony of a Salangueno diver's wife sheds light on the arrival of sea cucumber fishing to the Galapagos:



An artisanal fisherman's boat on the island of Isabela in the Galapagos. This photo depicts many changes in fishing techniques and equipment: traditional wooden boat's oars have been replaced by an outboard motor, the fishing line, hooks and nets have been replaced with an air compressor and hose called a hookah used for underwater diving to capture lobster and sea cucumber, and many of the wooden boats have now been replaced with larger fiberglass vessels. Photo: Jason Bremner.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Don't know/ No response
Total population	10.1	27.2	17.4	33.6	10.8	0.8
Migrants	12.9	28.0	17.1	29.8	10.5	1.7
Natives	7.7	26.5	17.6	37.1	11.1	—
Isabela	0.6	6.2	6.9	56.2	30.0	—

We worked with the Asians collecting sea cucumbers (on the coast) until there weren't any left and we went to Machala (southern coast). Then they said they were going to Galapagos with their people, and the Asian took my husband as a diver. Fifteen days later he brought me to live in Isabela. ...The Asian gave us money to return to Guayaquil, but we like the tranquility here. We've been in Isabela for ten years now.

There are upwards of 50 adults who are reef divers in Salango, and the majority of them described migrating to the Galapagos for varying amounts of time, ranging from just the months of the sea cucumber season to several years. Another fisherman living in the Galapagos stated: "I am from Salango, a port of fishermen. ...There is a connection with the Galapagos. My brother was here and many other Salangueños as well."

Interviews revealed that a large part of this wave of migrants arrived through family networks that already had been established through earlier migrations to the Galapagos. Families who had migrated to the Galapagos during the lobster boom or earlier helped family members and neighbors migrate to the islands.

Although the Asian exporters arrived in the Galapagos with their own divers, they also taught the resident fishermen the techniques of collecting, drying, and cooking the sea cucumbers. According to one Galapagos fisherman, "We had seen the sea cucumber littering the floor of the shallows for years." It did not take long to calculate that the low effort, low expense, and high price fetched by sea cucumber equated to lucrative profits. Both the older resident fishermen and the new migrant fishermen began to invest in the necessary equipment for sea cucumber fishing.

In the early 1990s, as sea cucumber fishing became established, concerns grew regarding the growing number of sea cucumber fishermen, fishing in sensitive waters, the presence of sea cucumber processing camps in restricted national park areas, and the potential ecological effects of a declining sea cucumber population. As a result, conservation organizations were able to convince the Ecuadorian government to declare a ban on sea cucumber fishing in 1992. The political and economic pressures to open the fishery, however, were very strong, and in 1994 the government opened an experimental three-month season for sea cucumber. A quota of 500 000 sea cucumbers was established. This number quickly was dismissed as too conservative, and estimates of the true catch for that season are between 5 and 6 million (3). In a short amount of time the sea cucumber had become the most lucrative fishery in the islands, and was reported to have been extremely profitable for the relatively small number of fishermen participating.

Park administrators and conservation organizations were alarmed at the size of the total sea cucumber catch in that first season, and were able in 1995 to establish an indefinite ban on sea cucumber fishing. Sea cucumber fishermen, including both natives and new migrants, raided the national park offices, destroyed property, and took Galapagos tortoises hostage to protest government restrictions on the fishery.

Despite political pressure and protests, the sea cucumber fishery remained closed for the next five years. During the closure government organizations and conservation groups searched for effective policies to regulate the sea cucumber fishery. In 1999 and 2000, in the context of political instability and an economic crisis in Ecuador, the sea cucumber fishery was reopened. In preparation for the opening of the 1999 season, export companies provided fishermen with loans that were invested in new fiberglass boats and fishing equipment (7). Native fishermen, migrant fishermen, and other people who were not traditionally fishermen quickly became engrossed, indebted, and fully dedicated to the sea cucumber season.

During these seasons, in contrast to the season of 1994, conservation organizations established systems with fishermen to monitor, manage, and patrol the fishery. Table 6 shows the es-

timated total annual catches in each of the subsequent sea cucumber seasons. The 2000 season was scheduled to last either three months or until the fixed quota of 4.5 million sea cucumbers was reached. On 11 July, 2000, the season was closed 11 days early when it was estimated that the quota had been surpassed.



Pesca de pepino mar AnDrumm:
Galapagos Sea Cucumber diver displaying his catch.
Photo: Andy Drumm.

Table 6. Total sea cucumber catch in Galapagos, by annual season.	
Year	Total (mill.)
1994	5.2
1999	4.4
2000	4.9

Table 7. Gross incomes and per capita gross incomes from the 1994, 1999, and 2000 seasons (USD).			
Year	Price per cucumber	Gross income	Per capita gross income*
1994	0.78	4.0 million	10 204
1999	0.77	3.4 million	5546
2000	0.73	3.6 million	5279

*Calculations based on the fisher registers in Table 2.

The regulation and closing of the season resulted in violent protests by fishermen who were increasingly bold in their contempt for government restrictions. Once again national park offices were ransacked and Galapagos tortoises were taken hostage. Marches and rallies in favor of the National Park and conservation efforts also were staged by concerned citizens.

The repeated protests seem to contradict the public opinion survey that showed that fishermen were in favor of moratoriums. If fishermen are in favor of moratoriums, why do the sea cucumber restrictions cause such anger? Interviews with fishermen revealed that they believe that growth in the number of fishers has caused declines in per capita profits. Table 7 shows that, even using the conservative data for the number of registered fishers, per capita profits have declined by more than 50%. According to fishermen, decreases in profits coincide with growing debt that has been accumulated in order to invest in more boats and equipment.

Decreases in profits also have been accompanied by an increase in the effort that fishermen must make to capture sea cucumbers. The sea cucumber monitoring project determined that the CPU declined by 40% from an average of 416 sea cucumbers/diver day in 1999, to 248 sea cucumbers/diver day in 2000 (14). Despite the decrease in CPU and the decrease in per capita profits, a cost benefit analysis of the three main fisheries (sea cucumber, lobster, and whitefish) in the Galapagos determined the sea cucumber to have the most profitable cost-benefit ratio (15). Murillo calculated that the sea cucumber still returns five times the profits of whitefish per dollar spent.

Now that the sea cucumber fishery is firmly established, several export companies operate in the Galapagos. Two export companies, Campresa and Gromodus, are registered in the Galapagos and control a large portion of the commercialization of the sea cucumbers captured in the islands. Additionally, there are more than 20 companies and people registered on the mainland that buy the product from middlemen and export the cucumbers to Hong Kong, Singapore, and Taiwan. The political influence of these export companies has yet to be investigated.

CONCLUSIONS

The rapid exploitation of the sea cucumber has in the past been blamed on the arrival of migrant fishermen from the coast. It is true that new migrants played a role in the start of sea cucumber fishing. However, the key factors that allowed for the efficient exploitation of the new resource were not the fishermen themselves but rather the new fishing techniques and access to credit and markets. This suggests that the annual sea cucumber crisis is due to factors more complex than that there are simply more fishermen generating greater sea cucumber catches. In fact, data show that despite the substantial increase in fishermen, fishing quotas have limited the overall catch. In addition, limiting the arrival of new migrants has not eased tensions. Protests followed the 2000 season, which was well after the special law restricting migration was enacted in 1998.

It is indisputable, however, that growing numbers of fishermen are changing the social, political, and most importantly, economic context of the Galapagos. Sea cucumber fishing has become a contentious issue with large numbers of supporters and dissenters. Despite the majority approval of fishing moratoriums, the enforcement of the quota system and seasonal restrictions still cause annual incidents of discontent. The current crisis more likely is related to the increase in competition and decrease in profitability of sea cucumber fishing than to the actual enforcement of regulations. Declines in CPU for sea cucumber suggest the crisis will continue as profits continue to weaken.

Future conservation in the Galapagos will depend on incorporating micro-level population-environment investigations into conservation planning and policies. Conservation authorities

should expect a repeating scenario of expanding markets, new fishing techniques, and diversification of fishing targets, regardless of the absence of future migration. Proper planning, restrictions, and research could avert a future boom-bust cycle that threatens the sea cucumber fishery. Recent efforts to create a participatory management structure for the marine reserve and marine resources will help the Galapagos avoid the controversy and protests that have made international news.

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